Closed Hybrid Hierarchical Reservoirs Based on the Deconstruction of the Cellular Native Microenvironment

J. Mano[1,2];

[1]University of Minho, Guimaraes, PORTUGAL, [2]PT Government Associate Laboratory, Braga/Guimaraes, PORTUGAL.

The stem cell niche organization and dynamics provide valuable cues for the development of mimetic environments that could have potential to stimulate the regenerative process. We propose the use of biodegradable biomaterials to produce closed miniaturised structures able to encapsulate different cell types or bioactive molecules. In particular, capsules are fabricated using the so-called layer-by-layer technology, where the consecutive (nano-sized) layers are well stabilized by electrostatic interactions or other weak forces. Using alginate-based spherical templates containing cells or other elements (e.g. proteins, magnetic nanoparticles, microparticles) it is possible to produce liquefied capsules that may entrap the entire cargo under mild conditions. The inclusion of liquefied micropcapsules may be used to produce hierarchical compartmentalised systems for the delivery of bioactive agents. The presence of solid microparticles inside such capsules offers adequate surface area for adherent cell attachment increasing the biological performance of these hierarchical systems, while maintain both permeability and injectability. We demonstrated that the encapsulation of distinct cell types (including mesenchymal stem cells and endothelial cells) enhances the osteogenic capability of this system, that could be useful in bone tissue engineering applications.